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8-2010

An Instrument to Measure Student Attitudes Toward and Perceptions of MIS: Exploring the Success of Efforts to Change Perceptions of the Field Across Time and Gender

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ABSTRACT

The Management Information Systems (MIS) field suffers from two pressing workforce issues, lack of diversity and an inadequate supply of entry level talent. Much has been done in the last five years to address these two related issues, but little is known about the success of these efforts. This study develops an instrument based on similar work in the hard sciences to measure 3 student attitudes towards MIS (Attitude toward success, usefulness, and effectance motivation) and student perceptions of both MIS and MIS professionals. Data was collected from 1102 college students over a 5 year period. Paired t-tests were used to test differences across time periods for each gender and to test differences between males and females within time periods. Surprisingly, little progress has been made to improve attitudes and perceptions. Interestingly, females and males do not currently view MIS differently.

Keywords (Required)

IT workforce, Gender in IT

INTRODUCTION

The use of Information Technology (IT) is pervasive and organizations continue to depend on IT for more and more of what they do. The ability to apply these technologies to innovate and reinvent business processes both internally and with trading partners is now paramount to success. This is not only true at the organization level, but also for entire economies. Worldwide, economies cannot function well without IT as demonstrated by increasing MIS related research into the global economy, that is now coined the new knowledge economy (Lee, Gholami and Tong 2005; Krishnan, Rai and Zmud 2007; Passerini and Fjermestad 2007), and the role of IT in sustainable development (Badamas 2009). The news is not all good about the pervasive role of IT in the economy. It has been asserted that IT played an influential role in the recent worldwide economic downturn (Pagano and Rossi 2009)

Accompanying the increasing need for IT in what we do is just as vital a need to develop a continual and diverse supply of IT talent into the workforce. Diversity in the IT workforce has long been recognized as an issue that needs to be addressed, especially the percentage of women in IT careers. This is not only a problem in the US where women make up only 26% of the IT workforce, but a global problem as well (Adam et al. 2006; Crump, Logan and McIlroy 2007; Adya, 2008; McKinney et al. 2008).

One often stated reasons for the lack of representation in women in IT is the male dominance of the field (Igbaria and Baroudi 1995, McKinney et al. 2008). Another is that women "have less innate ability or interest in the 'hard' sciences…" (McKinney et al. 2007 p. 81) leading to a lack of interest in IT careers. This assertion has long been a focus in the hard sciences (Sherman and Fennema 1977; Fennema and Sherman 1978). It has also been demonstrated in the hard sciences that with proper encouragement, headway can be made on the gender gap (Mason and Kahle 1988). However, between 1993 and 1999, while female representation in most science and engineering occupations in the US increased slightly, the percentage of women in computer occupations declined about 4% (Varma 2003). In the UK, the proportion of women in IT fell by 50% from 1999 to 2003 (Goodwin 2004).

From a US perspective, the lack of diversity prevails. Recently however, a much more looming supply issue has stepped to the forefront (Bullen et al. 2009). "U.S. demand for IS graduates is increasing, but graduation numbers from university IS programs are flat or in decline…many CIOs report continuing frustrations in attracting enough newly-minted IS talent." (Benamati, Ozdemir and Smith 2010, p. 1). The number of MIS graduates fell by 60% from 2003 to 2007 in top 50 business schools while demand projections continued upward (Benamati, Ozdemir and Smith 2010).

Both issues, diversity and supply, are being addressed on many fronts and with increasing urgency over the last five to seven years. From a pure supply perspective, the academy has been working to modify curriculum and market more aggressively to freshmen. We are also teaming with industry to improve the image of the field and educate high school students, parents, guidance counselors, and teachers about the opportunities and realities of careers in IT. On the gender front, concerted efforts to generate confidence in abilities and interest in the field for females continue. Organizations such as Women in Technology (www.womenintechnology.org), Computer Clubs for Girls (www.cc4g.net), and even the Girl Scouts who now offer technology related badges are all hard at work changing the image of the field.

MOTIVATION FOR THE STUDY

Many of these efforts to increase both overall supply and diversity started or increased in intensity in the last 5 years. The unanswered question is: are they having an effect? It may be too early to examine the IT workforce for answers, but some of the grassroots efforts in younger age groups should now show an effect at the post secondary level. Comparing attitudes and perceptions of college students toward the fields over the last four years may provide some insights into progress. Additionally, few studies look at MIS gender issues with college students as the unit of analysis. Most are industry studies. One study applied a Theory of Reasoned Action based model to examine the intention to choose an MIS major (Zhang 2007). Beyer (2008) performed an item level analysis focusing on intra-gender differences among female MIS majors and non-majors. A third study compared gender differences in measures of computer anxiety, self-efficacy, and gender typing gathered in 1995 and 2002 (Rainer, Laosethakul and Astone 2003).

The current study takes a different approach. It seeks to apply past research from the hard sciences (Fennema and Sherman 1976; Mason and Kahle 1988) to develop new construct measures of attitudes toward and perceptions of MIS. These constructs will be operationalized to measure progress in the recent more concerted efforts to change attitudes of MIS mentioned above. Once the instrument is established, the study uses that instrument to answer the following two research questions

> How has the way both male and female college students view MIS changed from 2005 to 2009?
> How has the way male and female college students view MIS differed over time?

Answering these questions will provide insight to the discipline as to how we are doing in our quest to change the image of MIS and attract a larger and more diverse workforce. Knowing this should help us to make decisions about how best to proceed in this endeavor.

RESEARCH METHODOLOGY

A survey methodology was used to collect data for the study. Data were collected from 1,102 students attending a university in the Midwestern United States. Students taking an introduction to MIS course required for all business students completed the survey. Participation was voluntary, and students were not rewarded in any way for their participation. Data was collected at the end of the spring semester sections of the course in four different years, from 2004 to 2009.

Table 1 summarizes the number of useful responses by year and gender. Of the 1,102 participants, males composed 57% of the sample. The subjects were also predominantly sophomores (86%), Juniors represented 11% of the sample with the remaining 4% spread across other class standings. Most, 87%, reported their age to be 19 or 20 which is consistent with students ending their second year of college studies

Measures

The research used a modified version of two established scales developed to study attitudes toward and perceptions of science and scientist (Mason and Kahle 1988). For both scales, questions were changed to ask about Management Information Systems and Management Information Systems Professionals instead of Science and Scientists. For example,

the item "Being regarded as smart in science would be a great thing" became "Being regarded as smart in Management Information Systems would be a great thing" and "Scientists often work as a team to solve problems" became "Management Information Systems professionals often work as a team to solve problems". All items used a one to five scale where 1 meant strongly agree and 5 meant strongly disagree.

Year	Total N	Female N	Male N
2004	200	109	91
2005	400	177	223
2008	223	77	146
2009	279	110	169

Table 1: Responses by Year

The Mason and Kahle (1988) attitudes scale was a shortened version of the Fennema and Sherman Mathematics Attitudes Scale (1976). Items for four constructs were converted to MIS items, Attitude Toward Success, Confidence in Learning, Effectance Motivation, and Usefulness. Of the Mason and Kahle (1988) items measuring these four constructs 21 of the 24 were converted to MIS items. One original item "Science is one of the most worthwhile and necessary subjects to take." was split into two items one asking about how worthwhile MIS is and the other about how necessary MIS is resulting in 22 total attitude items.

The Mason and Kahle (1988) perception scale measured two constructs, student perceptions of science and of scientists professionals. The scale consisted of 16 items for student perceptions of science and 23 for perception of scientists. For brevity, 11 items were converted to perceptions of MIS items and 6 to perceptions of MIS professional items. Items not converted included those less relevant when applied to MIS such as "Scientific research is done using rats, mice, and chemicals" and "Scientist usually wear white laboratory coats." Table 2 lists and defines the six constructs measured in the survey.

	Definition
Attitude Constructs	
Attitude Toward Success	The degree to which students anticipate positive or negative consequences as a result of success in MIS
Usefulness	Usefulness of MIS currently, and in relationship to their future education, vocation or other activities.
Confidence in Learning	Confidence in one's ability to learn and to perform well on MIS tasks
Effectance Motivation	Intrinsic joy from doing MIS
Perception Constructs	
MIS	How students view the Management Information Systems discipline
MIS Professionals	How students view Management Information Systems professionals

Table 2: Constructs and Definitions

CONFIRMING THE MEASUREMENT MODELS

Confirmatory factor analysis using SAS version 9.2 using the data from 2004 (N=200) was performed to test the proposed measurement model. Due to expected high correlations between some of the items across the two scales for the perception and attitude constructs the measurement models were confirmed separately. A strictly confirmatory use of CFA would test the fit of the data collected to a posited measurement model and accept or reject it. However, model generation is a more commonly used application of CFA (Joreskog, 1993). In this approach, an initial model is tested for fit against collected data. If the fit is not adequate, the model is adjusted and re-tested. This process iterates until an appropriate level of fit is obtained. The analysis in this study employed such a model generation approach since it employed modified measures developed from the hard sciences to measure attitudes and perceptions of MIS. Initial indicators of fit for the both posited measurement models are in Table 3.

The chi-square to degrees of freedom ratios for both models were above the recommended acceptable value of 2.0. The CFI, AGFI, and NNFI values were below the recommended 0.90 and the RMSEA values were above 0.06. However, the fit of both models was good enough to indicate the potential that, with adjustment, models could be generated that displayed a good fit.

Fit Indicator	Attitude Measurement Model	Perceptions Measurement Model
RMSEA	0.084	0.091
GFI	0.80	0.84
AGFI	0.75	0.80
NNFI	0.83	0.78
chi-square	501.44	326.12
df	203	118
chi-square/df	2.47	2.76

Table 3: Initial Fit Indicators for Both Measurement Models

Problems of fit result when the observed covariances between items differ from those predicted in the model. This occurs when an item does not covary with its posited factor. In this situation, the covariance between this item and others measuring the same factor will be over predicted in the model and the item in question should be removed.

Predicted and actual covariances may also differ if an item actually measures a factor other than its posited factor. In this case, the model will under predict the covariance between an item and the items measuring the other factor. The item may indeed measure both factors, but it is highly desirable to have unidimensional items. The preferred remedies for this problem are to move the item to the other factor or to remove it from the model. Since the items in these scales were adapted from established scales, such items were removed from the model.

Problems of fit are thus determined through a comparison of the predicted verses observed covariances. SAS provides a residual matrix that illustrates the difference between corresponding values in the predicted and observed covariance matrices. Large residuals indicate poor fit. Large negative residuals indicate under predicted covariances and positive residuals indicate over prediction. Model respecification decisions can be made based on patterning these residuals (Anderson and Gerbing, 1988; Hatcher, 1994).

In the model generation process for the attitude measurement model, six items were dropped (one at a time) due to large residuals. For the Perceptions measurement model, five items were dropped again due to residuals. Both processes resulted in models that fit the data well as illustrated in Table 4. The chi-square to degrees of freedom ratios were below 2.0 for both models. The CFI and NNFI values were greater than 0.9 and both had an RMSEA below 0.06. Therefore, the models were accepted (Bentler, 1989; Bentler and Bonett, 1980; Hatcher, 1994).

Fit Indicator	Attitude Measurement Model	Perceptions Measurement Model
RMSEA	0.059	0.028
GFI	0.90	0.95
AGFI	0.87	0.93
NNFI	0.92	0.98
chi-square	194.08	61.61
df	113	53
chi-square/df	1.72	1.16

Table 4: Final Fit Indicators for Both Adjusted Measurement Models

Appendix 1 lists the resulting items for the six factors. Table 5 lists the chronbach alphas and composite reliability values for each factor. Coefficient alpha is one of the most widely used internal consistency reliability indices in the social sciences (Hatcher, 1994). A widely used rule of thumb is that alphas and composite reliability values should preferably exceed 0.70

with values above 0.60 considered minimally acceptable (Hatcher, 1994; Nunnally, 1978). For this model, all alphas are greater than 0.70 except that of attitude toward success (alpha 0.66 and composite reliability 0.67) which was well above the 0.60 minimum. Thus, the factor items in the model have acceptable internal consistency.

Factors/ Indicator Variables	Coeff. Alpha/ Standardized Loading	t	Composite/ Indicator Reliability
Attitude Toward Success	0.66		0.67
A1	0.708	10.64	0.501
A2	0.619	9.09	0.383
A3	0.581	8.43	0.338
Usefulness	0.83		0.83
U1	0.806	13.42	0.650
U2	0.800	13.27	0.640
U3	0.713	11.29	0.508
U4	0.554	8.20	0.307
U5	0.601	9.06	0.361
Confidence in Learning	0.74		0.74
C1	0.652	9.49	0.425
C2	0.770	11.63	0.593
C3	0.632	9.14	0.399
C4	0.524	7.32	0.275
Effectance Motivation	0.77		0.77
E1	0.558	8.29	0.311
E2	0.725	11.54	0.526
E3	0.538	7.92	0.289
E4	0.868	14.81	0.753
MIS	0.82		0.84
M1	0.835	14.31	0.697
M2	0.425	6.11	0.181
M3	0.401	5.75	0.161
M4	0.694	11.01	0.482
M5	0.802	13.47	0.643
M6	0.856	14.85	0.733
MIS Professionals	0.71		0.71
P1	0.391	5.15	0.153
P2	0.400	5.27	0.160
P3	0.534	7.27	0.285
P4	0.721	10.25	0.520
P5	0.687	9.70	0.472
P6	0.489	6.55	0.239

Table 5: Reliability and Validity Summary Information

Table 5 also lists the loadings and t-test values for each indicator variable for its posited factor. Factor loadings were all above 0.39 and significant at p>.001 indicating convergent validity in the items (Hatcher 1994). To test discriminant validity, separate models where run constraining each pairwise correlation between the factors to 1. The resulting chi-square values for each constrained model were compared to the chi-square value in the original CFAs for the appropriate

measurement model. A significant degradation in the resulting chi-square value with one degree of freedom provides evidence that the constructs are in fact discriminant. The chi-square values differences based on one degree of freedom were highly significant (p<.001) for 6 of the 7 constrained models. The final constrained model was significant at the .025 level. Based on model fit and the examination of alternative models, construct unidimensionality and discriminant validity are confirmed.

After using the 2004 data to set the scales, Chronbach alphas were calculated for the data from all subsequent years to further demonstrate the reliability of the measurement model. All alphas except attitude toward success in 2009 were above .60. Although I continue to report results for attitude toward success throughout the paper, the results are in question due to the weaker reliability in the scales for that factor. Table 6 lists the alphas for all factors for all years.

	Alphas			
Construct	**2004**	**2005**	**2008**	**2009**
Attitude Toward Success	0.66	0.63	0.61	0.58
Usefulness	0.83	0.81	0.85	0.87
Confidence in Learning	0.74	0.72	0.78	0.78
Effectance Motivation	0.77	0.73	0.76	0.78
MIS	0.82	0.80	0.84	0.86
MIS professionals	0.71	0.64	0.64	0.72

Table 6: Alphas for the Constructs across the Data Sets

ANALYSIS TO ANSWER THE RESEARCH QUESTIONS

To answer the two research questions (How has the way both male and female college students view MIS changed from 2005 to 2009? and How has the way male and female college students view MIS differed over time?) the sample was split based on gender. Paired t-tests were then used to test differences across time periods for each gender and to test differences between males and females within time periods.

For the first question, Table 7 summarizes and Figure 1 illustrates the differences for females across years. Likewise, Table 8 and Figure 2 summarize and illustrate the difference for males across years. The tables and figures indicate that from the period from spring 2005 to spring 2008, significant ground was lost in three of the four attitude constructs and in their perception of MIS. For males, although only marginally significant, results are similar. Interestingly, between April 2008 and April 2009, a significant improvement has taken place in both genders for effectance motivation as well as perceptions of MIS and IS professionals. Additionally, there was a marginal improvement in males' attitude about the usefulness of MIS.

Construct	2005 Mean	2008 Mean	2009 Mean	05 to 08 t-test significance	05 to 09 t-test significance	08 to 09 t-test significance
Attitude toward Success	2.32	2.42	2.31	0.255	0.853	0.227
Usefulness	2.49	2.76	2.56	0.006***	0.463	0.108
Confidence in Learning	2.53	2.76	2.62	0.016**	0.353	0.221
Effectance Motivation	3.19	3.49	3.21	0.003***	0.797	0.022**
Perception of MIS	3.06	3.32	3.10	0.008***	0.660	0.061*
Perception of MIS Professionals	2.45	2.52	2.30	0.388	0.020**	0.011**

Note: recall that the scale on the items was 1 (strongly agree) to 5 (strongly disagree)
***** p< 0.01, ** p < 0.05, * p< 0.10**

Table 7: T-test Comparisons of Females Views of MIS Over Time.

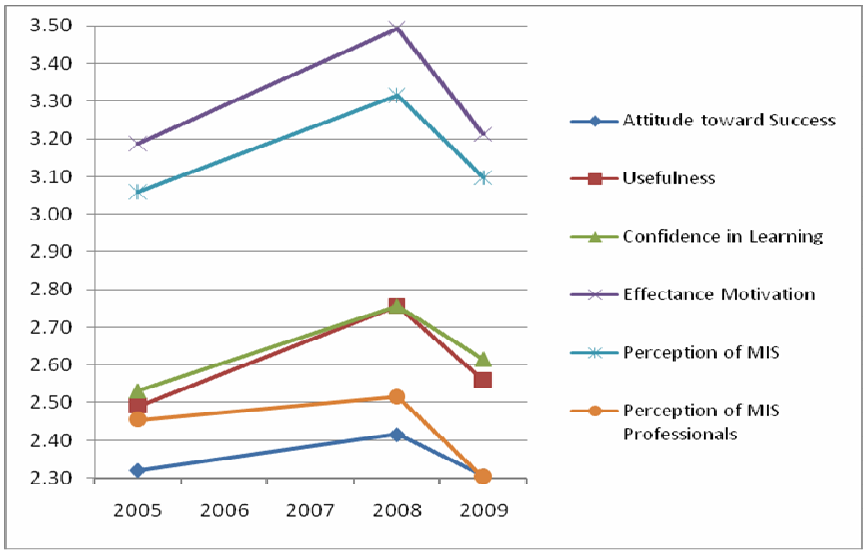

Figure 1: Changes in Female Construct Means Over Time

Construct	2005 Mean	2008 Mean	2009 Mean	05 to 08 t-test significance	05 to 09 t-test significance	08 to 09 t-test significance
Attitude toward Success	2.46	2.46	2.39	0.942	0.320	0.327
Usefulness	2.65	2.80	2.62	0.063*	0.763	0.061*
Confidence in Learning	2.49	2.48	2.50	0.857	0.932	0.801
Effectance Motivation	3.17	3.33	3.13	0.058*	0.588	0.026**
Perception of MIS	3.12	3.27	3.10	0.0504*	0.798	0.047**
Perception of MIS Professionals	2.63	2.61	2.47	0.700	0.006***	0.019***

Note: recall that the scale on the items was 1 (strongly agree) to 5 (strongly disagree)
***** p< 0.01, ** p < 0.05, * p< 0.10**

Table 8: T-test Comparisons of Males Views of MIS Over Time.

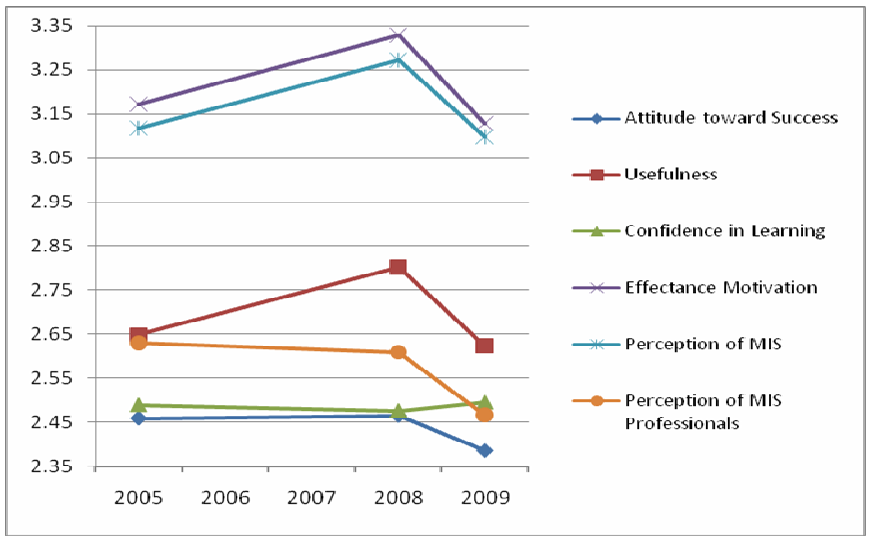

Figure 2: Changes in Male Construct Means Over Time

For the second question, Table 9 summarizes the results of the t-tests. Females felt more positively about attitude toward success, usefulness, and MIS professionals than males in 2005. In 2008, the only difference between the genders was males had more confidence in learning MIS. Finally in 2009, females again perceived MIS more positively than males did.

	2005			2008			2009		
	Female Mean	Male Mean	Signif.	Female Mean	Male Mean	Signif.	Female Mean	Male Mean	Signif.
Attitude toward Success	2.32	2.46	0.043*	2.42	2.46	0.59	2.31	2.39	0.333
Usefulness	2.49	2.65	0.025*	2.76	2.80	0.61	2.56	2.62	0.392
Confidence in Learning	2.53	2.49	0.963	2.76	2.48	0.01**	2.62	2.50	0.328
Effectance Motivation	3.19	3.17	0.996	3.49	3.33	0.29	3.21	3.13	0.9629
Perception of MIS	3.06	3.12	0.531	3.32	3.27	0.23	3.10	3.10	0.930
Perception of MIS Professionals	2.45	2.63	0.002**	2.52	2.61	0.18	2.30	2.47	0.023*

Note: recall that the scale on the items was 1 (strongly agree) to 5 (strongly disagree)
**** p < 0.01, ** p < 0.05**

Table 9: T-test Comparisons of Males and Females Views Each Year

DISCUSSION

Keeping in mind the direction of the scale for the items from 1 strongly agree to 5 strongly disagree, it appears the only significant movement in either gender between 2005 and 2008 was for the worse. Most surprising was the across the board degradation in female attitudes and perceptions of MIS. All the means were higher in 2008 than 2005. Four of the six constructs differed significantly, confidence in learning MIS, effectance motivation, usefulness of MIS, and perceptions of MIS. This finding is unexpected given increased efforts to attract females to the field. Even more surprising is the drastic improvement from 2008 to 2009. During that very tough 12 month economic period, the means improved for all female attitudes towards and perceptions of MIS. Only effectance motivation and perception of MIS professionals significantly changed. Perception of MIS marginally improved. Interestingly, female student perception of MIS professionals improved drastically during the economic downturn and showed significant improvement over 2005 as well. This construct only was significantly different across four years for female subjects.

Male attitudes did not change as drastically from 2005 to 2008. Three of the item means were virtually unchanged and the others, usefulness, effectance motivation, and perceptions of MIS only marginally changed. From 2008 to 2009, the changes for males mirrored those of females. Significant improvement in effectance motivation, perceptions of MIS, and perception of MIS professionals took place along with marginal improvement in usefulness attitude. Only male perceptions of MIS professionals improved across the four years.

When comparing male to female attitudes and perceptions within time periods, again some surprises were found. In 2005, females had better attitudes toward success, usefulness, and perceptions of MIS professionals than males. This changed in 2008 when the only difference was males' more confident attitude about learning MIS. By 2009, males and females thought differently only about MIS professionals with females regarding them better than males.

In light of the concerted efforts to improve attitudes about and perceptions of the field, these findings probably raise more questions than they answer. It appears that female attitudes and perceptions are at least on par with males and that the economic crisis of the last twelve months had a positive effect on student attitudes towards and perceptions of MIS. Future research will need to be done to understand why this is so.

CONTRIBUTIONS

This paper contributes in two significant ways. First it develops an instrument based in the hard sciences to study students' attitudes toward and perceptions of MIS. The scales develop here have applications to MIS research going forward. Secondly, it provides some insight into how well we are doing as a field in addressing the need for a continual and diverse supply of IT talent into the workforce. It appears that we have work left to do.

CONCLUSION

It appears that some progress has been made in the mismatched supply and demand curves for MIS graduates. Females appear to not significantly differ from males in their views of the field. This could be an important first step in fixing both diversity and capacity IT workforce issues going forward.

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Appendix 1: Survey Items

Attitude Scale Constructs and Items

Attitude toward Success

A1 One of my highest priorities is to be an outstanding student in Management Information Systems
A2 Being regarded as smart in Management Information Systems would be a great thing
A3 It is very important for me to get top grades in Management Information Systems

Usefulness

U1 Management Information Systems is one of the most worthwhile subjects to take
U2 Management Information Systems is one of the most necessary subjects to take
U3 I study Management Information Systems because I know how useful it is
U4 I see Management Information Systems as a subject I will rarely use in my daily life as a business person
U5 I will use Management Information Systems in many ways as a business person

Confidence in Learning

C1 I'm not the type to do well in Management Information Systems.
C2 I have a lot of self-confidence when it comes to Management Information Systems.
C3 For some reason, even though I study, Management Information Systems seems unusually hard for me
C4 I am sure that I can learn Management Information Systems

Effectance Motivation

E1 When a question is left unanswered in Management Information Systems class, I continue to think about it afterward
E2 Figuring out Management Information Systems problems does not appeal to me
E3 I would rather have someone give me the solution to a difficult Management Information Systems problem than to have to work it out for myself
E4 Management Information Systems are enjoyable and stimulating to me

Perception Scale Constructs and Items

Perception of MIS

M1 Working in Management Information Systems is very exciting
M2 Working in Management Information Systems is very frustrating
M3 Management Information Systems is mostly unrelated facts which you have to memorize
M4 Management Information Systems is often boring
M5 Management Information Systems is fun to think about
M6 Management Information Systems is very interesting

Perception of MIS Professionals

P1 Management Information Systems professionals often work as a team to solve problems
P2 People who work in Management Information Systems careers don't have the opportunity to travel much in their work; they spend most of their time at their workplace
P Like artists and musicians, Management Information Systems professionals are very creative in their work
P4 A Management Information Systems professional must be able to talk with many different people
P5 Those who work in Management Information Systems careers frequently use their listening skills
P6 In order to work in Management Information Systems, one needs good writing skills